IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No.: 10/791,030
First Named Inventor: Xinye Liu

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Art Unit: 1763

Examiner: Zervigon, Rudy
Confirmation No.: 1253

Commissioner for Patents
P.O. Box 1450
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APPEAL BRIEF

Sir:

This Brief is submitted in support of this appeal, mailed December 5, 2006, from a final decision of the Examiner, mailed June 5, 2006, and an Advisory Action, mailed April 3, 2007. Consideration of this appeal by the Board of Patent Appeals and Interferences for allowance of the above-captioned patent application is respectfully requested.

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I. REAL PARTY IN INTEREST

The real party in interest is Genus, Inc., a corporation of California having a principal place of business at, 1139 Karlstad Drive, Sunnyvale, CA 94089.

II. RELATED APPEALS AND INTERFERENCES

This application has not previously been the subject of an appeal or interference proceeding.

III. STATUS OF CLAIMS

Claims 1-55 and 71-74 have been cancelled. Claims 56-70 are currently pending, have been finally rejected, and are the subject of this appeal.

IV. STATUS OF AMENDMENTS

There are no currently pending amendments.

V. SUMMARY OF CLAIMED SUBJECT MATTER

Claim 56 reads as follows:

56. An atomic layer deposition (ALD) apparatus, comprising

a first gas flow pathway coupled upstream of a reaction chamber (410, 510, 610, 710, 810) and having switchable first and third flow limiting conductances (405, 407, 428, 505, 507, 528, 644, 646, 628, 744, 746, 728) such that during an expose period of an ALD process the first gas flow pathway is operable to provide a first flow from a first pressure source (411, 511, 648, 748) to the reaction chamber and during a reactant removal purge period of the ALD process the first gas flow pathway is operable to provide a second flow from a second pressure source (409, 509, 646, 746) to the reaction chamber, the second pressure source having a greater pressure than the first pressure source; and

a second gas flow pathway coupled downstream of the reaction chamber and having switchable second and fourth flow limiting conductances (422, 434, 542, 534, 622, 722), a ratio of the first flow limiting conductance to the second flow limiting conductance being nominally equal to a ratio of the third flow limiting conductance to the

fourth flow limiting conductance, configured such that during the ALD process a nominally constant pressure in the reaction chamber can be maintained.

Claim 62 reads as follows:

62. An atomic layer deposition (ALD) system, comprising:

a gas flow pathway coupled upstream of a reactor chamber (410, 510, 610, 710, 810) through selectable upstream flow limiting conductances (405, 407, 428, 505, 507, 528, 644, 646, 628, 744, 746, 728) having two or more operational modes including a low flow mode and a high flow mode; and

a pumping arrangement (430, 432, 530, 532, 630, 730) coupled downstream of the reactor chamber through selectable downstream flow limiting conductances (405, 407, 428, 505, 507, 528, 644, 646, 628, 744, 746, 728) having two or more operational modes including a low flow mode and a high flow mode,

wherein the upstream flow limiting conductances and downstream flow limiting conductances are configured to switch operational modes in time-phase with one another.

As indicated by these claims, the present invention relates to an atomic layer deposition (ALD) apparatus that provides low flow levels concurrently matched to low pumping capacities during exposure times and high flow levels concurrently matched with higher pumping capacities during purge times. Additionally, where the reactor chamber pressure is to be constrained at a nominally constant pressure, the present invention allows for the same by maintaining the throttle valve less open at low flow rates during reactant exposure and more open at high flow rates during purge. Further, because an ALD half- reaction for a first precursor (A) may be very different from that for a second precursor (B), the flow rates during the A cycle and the B cycle may be different. To accommodate the need for varying exposure flow rates due to different precursor requirements, the present invention provides for a "multi- value" or multi- level" flow rate, consisting of two or more flow levels.

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

Claims 56-70 stand rejected under 35 U.S.C. § 112, first paragraph, for allegedly failing to comply with the written description requirement.

Claim 58 stands rejected under 35 U.S.C. § 112, first paragraph for allegedly failing to comply with the enablement requirement.

The drawings have been objected to under 37 CFR 1.83(a).

VII. ARGUMENT

Rejection of Claims under 35 U.S.C. § 112 – Written Description

In the Office Action of June 5, 2006, the Examiner rejected claims 56-70 under 35 U.S.C. § 112, first paragraph, for allegedly failing to comply with the written description requirement. In particular, the Examiner stated, "[t]he claims contains (sic) subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventors, at the time the application was filed, had possession of the claimed invention." Applicants respectfully disagree. Applicants submit that persons of ordinary skill in the art, who have read Applicants' specification, would clearly recognize that the Applicants in fact invented what is claimed.

First, Applicants point out that the subject matter of the claims need not be described literally (i.e., using the same terms or in *haec verba*) in order for the disclosure to satisfy the description requirement. That is, the claim language need not be identical to the language in the specification providing support for the claim. For example, in the case of claim 56, the claim refers to first and second "flow limiting conductances." The Examiner suggests that he cannot determine an equivalent for a "flow limiting conductance", but then goes on to identify several equivalents in asking, "[c]an a flow limiting conductance be a valve, a diffuser, a restrictor, a flow meter, or any other multitude of flow controlling elements?" The answer is yes.

After reading Applicants' specification, one skilled in the art will appreciate and understand that in the context of the claimed invention (e.g., claim 56), a flow limiting conductance can be a component, or combination of components, controlling a gas flow between a source and an entrance to a reactor. The concept of a flow limiting conductance is described in various places in the specification. For example, paragraph [0036] states:

> Various "restrictors" and conduit conductance limitations as may be useful may be placed in the gas switching manifold 102 (e.g., in reactor purge pathways 126 and 124), but are not shown in detail. Where used such restrictors and conductances may also determine the quantitative pressure and flow values.

Accordingly, it is clear from the specification that a "conductance" is a component used to control flow. Applicants submit that one skilled in the art would not be making much of a mental leap in determining that a "flow limiting conductance" (as the term is used in claim 56) is a conductance that determines or controls a flow value of a gas flow.

In addition, paragraph [0048] states:

> In a second method, the purge flow is controlled by switching upstream, flow limiting conductances (e.g., from a low to a high value for low and high flow, respectively) in time-phase with downstream conductances (e.g., from a low to a high level for low and high flow, respectively). This method is referred to herein as "tracking conductance(s)" in the system. This approach provides not only the ability to keep the pressure of the reactor nominally constant (as long as the fraction of upstream and downstream conductances are the same at any point in time during the switching cycle), but also allows for a wide dynamic range of purge flows. The upstream switching conductances may be placed in a variety of configurations: for example, in series with or imbedded within a split-flow chemical manifold, or in parallel with the chemical delivery manifold lines. The downstream switching conductances may also be placed in a variety of positions: for example, in the locale of the first downstream constriction just downstream from the reaction zone, or integrated as part of the downstream throttle valve (which in this case is controlled independently so as to assume designed positions or openings and is not used in a closed loop control mode).

Paragraph [0048] not only provides support for the claimed invention – particularly the concept of a flow limiting conductance – but it also suggests several components (e.g., throttle valve or switching valve) and configurations that may be used as flow limiting conductances.

In one last example, paragraph [0051] of the specification states in connection with the description of FIG. 4:

> Given the current state of the art, the pressure controllers 409 and 411 cannot be fast gas switched below several hundred milliseconds (however, future pressure controllers may allow for direct, fast electronic control). We avoid this shortcoming by passing the pressurized gas through fast switching pneumatic valves (with conductances determined by the conduit lines, elbows, valve and any restrictor components in the lines between the pressure sources 409/411 down to and including the entrance 428 to the reactor 410).

Accordingly, one skilled in the art will appreciate and understand that in the context of the claimed invention, a flow limiting conductance is a component, or combination of components, controlling a gas flow between a source and an entrance to a reactor. Furthermore, one skilled in the art will appreciate and understand that, in the context of various different embodiments of the invention, a flow limiting conductance may be different components, or

combination of components. In any case, Applicants submit that the specification provides support for the claims as filed.

Rejection of Claim 58 under 35 U.S.C. § 112 – Enablement

The Examiner has rejected claim 58 under 35 U.S.C. § 112, first paragraph for failing to comply with the enablement requirement. In particular, the Examiner states, "Applicant's (sic) specification is devoid of an enabling disclosure for a 'plasma-assisted process.'" Applicants respectfully disagree. Applicants submit that persons of ordinary skill in the art, who have read Applicants' specification (paragraph 83 in particular), would understand how the claimed invention pertains to plasma-assisted processes.

Objection to the Drawings under 37 CFR 1.83(a)

In the Office Action of June 5, 2006, the Examiner objected to the drawings under 37 CFR 1.83(a). In the Office Action, the Examiner enumerated several elements that the Examiner alleges are not "detailed in either the specification as filed and amended ... and not detailed in the drawings." Consequently, the Examiner suggests that he "cannot determine equivalents in the prior art." Applicants respectfully disagree.

Again, the Examiner is reminded that the claim language need not be identical to the language used in the specification as used to describe the drawings. Despite stating that he cannot determine equivalents to such claimed elements as a "flow limiting conductance", in the Office Action the Examiner provides a list of no less than four potential equivalents (e.g., a valve, a diffuser, a restrictor, a flow meter) for a flow limiting conductance. Applicants submit that, to the extent a claimed element is essential to a proper understanding of the invention, the element is illustrated in the drawings.

Take for example independent claim 56 and FIG. 4. The Examiner has suggested that "first pressure source" and "second pressure source" are claimed elements (from claim 56) that are not detailed in the specification and drawings. Applicant's submit that one skilled in the art will appreciate and understand that the boxes in FIG. 4 with reference numbers 409 and 411, which are referred to in the specification as representing pressure controllers, are first and second "pressure sources" for purposes of illustrating claim 56. Similarly, Applicants submit that one skilled in the art will understand and appreciate that the claimed elements "first gas flow pathway" and "second gas flow pathway" are conventional elements represented in the drawings by simple lines showing the directional flow of a gas (e.g., lines with reference numbers 124 and 126 in FIG. 1, and 424 and 426 in FIG. 4).

For at least the foregoing reasons, the claims are patentable over the references cited in the Office Action. If there are any additional fees due in connection with this communication, please charge our deposit account no. 19-3140.

Respectfully submitted,
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APPENDIX A: Claims on Appeal
(37 C.F.R. § 41.37(c)(1)(viii))

The claims on appeal read as follows:

Claims 1-55 (Cancelled)

56. (Previously Presented) An atomic layer deposition (ALD) apparatus, comprising

a first gas flow pathway coupled upstream of a reaction chamber and having switchable first and third flow limiting conductances such that during an expose period of an ALD process the first gas flow pathway is operable to provide a first flow from a first pressure source to the reaction chamber and during a reactant removal purge period of the ALD process the first gas flow pathway is operable to provide a second flow from a second pressure source to the reaction chamber, the second pressure source having a greater pressure than the first pressure source; and

a second gas flow pathway coupled downstream of the reaction chamber and having switchable second and fourth flow limiting conductances, a ratio of the first flow limiting conductance to the second flow limiting conductance being nominally equal to a ratio of the third flow limiting conductance to the fourth flow limiting conductance, configured such that during the ALD process a nominally constant pressure in the reaction chamber can be maintained.

57. (Previously Presented) The ALD apparatus of claim 56, wherein the first gas flow pathway is configured to provide a first gas for the first flow different from a second gas for the second flow.

58. (Previously Presented) The ALD apparatus of claim 56, wherein the expose period comprises a plasma-assisted process.

59. (Previously Presented) The ALD apparatus of claim 56, wherein the first gas flow pathway is configured such that the first flow limiting conductance is switched to the third flow limiting conductance at a substantially coincident point in time as the first flow is switched to the second flow.

60. (Previously Presented) The ALD apparatus of claim 56, wherein the first gas flow pathway is configured so that the first flow is switchable to the second flow prior to completion of material deposition during the expose period.

61. (Previously Presented) The ALD apparatus of claim 56, wherein the second gas flow pathway is configured such that the second flow limiting conductance in the second gas flow pathway is switchable to the fourth flow limiting conductance at a different point in time than that at which the first flow is switched to the second flow.

62. (Previously Presented) An atomic layer deposition (ALD) system, comprising:

a gas flow pathway coupled upstream of a reactor chamber through selectable upstream flow limiting conductances having two or more operational modes including a low flow mode and a high flow mode; and

a pumping arrangement coupled downstream of the reactor chamber through selectable downstream flow limiting conductances having two or more operational modes including a low flow mode and a high flow mode,

wherein the upstream flow limiting conductances and downstream flow limiting conductances are configured to switch operational modes in time-phase with one another.

63. (Previously Presented) The ALD apparatus of claim 62, wherein the upstream flow limiting conductances are configured to switch operational modes prior to the downstream flow limiting conductances switching operational modes.

64. (Previously Presented) The ALD apparatus of claim 62, wherein the downstream flow limiting conductances include a throttle valve.

65. (Previously Presented) The ALD apparatus of claim 64, wherein the throttle valve comprises an annular throttle valve located within the reactor chamber.

66. (Previously Presented) The ALD apparatus of claim 65, wherein the annular throttle valve includes multiple vanes, each having an axis therethrough.

67. (Previously Presented) The ALD apparatus of claim 65, wherein the annular throttle valve includes includes multiple blades arranged in an iris configuration.

68. (Previously Presented) The ALD apparatus of claim 65, wherein the annular throttle valve includes multiple blades, each having a number of holes therethrough, at least one of the blades being rotatable about an axis such that holes extending through the rotatable blade align with holes of at least one of the other blades to provide a passage through the annular throttle valve.

69. (Previously Presented) The ALD apparatus of claim 62, wherein the gas flow pathway comprises multiple gas flow pathways for purge gasses and chemical precursors which share one or more common inputs to the reactor chamber.

70. (Previously Presented) The ALD apparatus of claim 62, wherein the upstream flow limiting conductances and downstream flow limiting conductances are configured to switch operations modes according to a difference in residence times for passage of gas between (i) the upstream conductances and the reaction chamber, and (ii) the reaction chamber and the downstream conductances.

Claims 71-74 (Cancelled)

APPENDIX B: Other Evidence
(37 C.F.R. § 41.37(c)(1)(ix))

There is no evidence submitted under 37 CFR 1.130, 1.131 or 1.132, or other evidence entered by the examiner and relied upon by the appellant in this appeal.

APPENDIX C: Related Proceedings
(37 C.F.R. § 41.37(c)(1)(x))

There are no related proceedings to report.